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## Excursion 4 Shawhead, Crocketford: Gala and Hawick groups, sculptures and monuments

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OS 1:50 000 Sheet 84 Dumfries, Castle Douglas 6-surrounding area

BGS 1:50 000 Sheet 9E Thornhill

Route map: (Figure 20)

**Main points of interest** This excursion considers the tract-defining fault between the Gala and Hawick groups and the lithologies to either side. Localities visited allow comparisons to be made between the Gala Group and Hawick Group turbidites, which contrast greatly in their depositional style. Moffat Shale Group strata are also examined. The area is notable for the presence of works by renowned sculptors, including Rodin and Henry Moore, placed near public roads on the Glenkiln estate by the local landowner. Monuments of historical interest are also a feature of the area.

**Logistics** There is no public transport. The use of a private car or minibus is advised as local roads are too narrow for a large coach. The excursion localities are at distances of 100 m to 1 km from the roadside. With the exception of the first locality, which is up a steep hillside, walking is of an easy nature. However, boots are advised as there are wet and muddy patches. A full day will be needed if all suggested localities are visited; a half day will be sufficient if only the stops close to the road are considered. Access in the area around the sculptures is not a problem, but these are very popular with visitors, and in summer the roads in their vicinity are often lined with cars. Permission to visit Localities 6 and 7 should be requested at Glen Farm, part of the Glenkiln estate. Permission for access to Localities 8 and 9 should be requested at Larghill Farm. Localities 11 and 12 are part of Crofts Farm (Figure 20).

### Introduction

Major faults, components of an imbricate thrust stack, divide the Southern Uplands sequence of steeply dipping turbidites and pelagic shales into a series of tectonostratigraphical tracts (Figure 1). The fine-grained sedimentary rocks of the Moffat Shale Group are relatively soft and the tract-defining faults formed preferentially within them. Thus the line of faulting is often marked by a series of Moffat Shale inliers and in areas of poor exposure, may be expressed as a topographic low across the landscape where the softer Moffat Shales have been preferentially eroded. Where sequences of turbidites are faulted against each other, without intervening shales, the line of the fault is very much more difficult to trace.

The Laurieston Fault, which defines the boundary between the Silurian Gala and Hawick groups of the Southern Uplands' Central Belt (Figure 1) and (Figure 2), can be traced across the area around Glenkiln Reservoir (Figure 20). (This is not the locality after which the Glenkiln Shale of Llandeilo-Caradoc age is named; that locality is included in Excursion 18). NW of the Laurieston Fault lies the Moffat Shale Group (Ordovician to Silurian) overlain by greywackes of the Gala 7 unit (Silurian). SE of the fault is exposed the Cairnharrow Formation (Silurian), the oldest unit of the Hawick Group.

Gala 7 turbidites in this area are typically thickly bedded and dominated by apparently structureless, medium-to coarse-grained or pebbly, non-calcareous sandstones. Bedding is often difficult to distinguish and sole structures and ripple crossbedding are rare. In contrast, bedding in the Cairnharrow Formation is readily recognised and sole structures and ripple cross-bedding are common. Cairnharrow Formation greywackes are generally finer grained than those of the Gala Group, with fewer pebbles, and red detrital, mica flakes may be present as a distinctive component. Cairnharrow Formation turbidites may also be calcareous, which is a general characteristic of the Hawick Group. Despite their differences, both formations were deposited on submarine fans in a mid-fan setting (Figure 7). Gala 7 turbidites, however, were deposited from more highly concentrated, channelled flows.

## 1 Cornlee Bridge: Gala 7 coarse-grained turbidites

Take the A75 west from Dumfries. The right turn to Shawhead is on a straight stretch of the road, approximately 8 km from the end of the Dumfries bypass and is clearly marked by a signpost. In the centre of Shawhead village turn right, almost immediately left, out of the village, and left again towards Glenkiln. After a distance of 3 km the road follows the bank of the Glenkiln Reservoir. At the head of the reservoir leave the vehicle in a small parking place [NX 829 785] adjacent to a statue by Rodin known as 'Moses'.

From the parking place follow the Marglolly Burn 400 m upstream to Cornlee Bridge. An abstract bronze sculpture is positioned nearby. Cross the bridge, leave the road and ascend a rough path for approximately 250 m NE to the first prominent knoll [NX 839 790]. Around you are many exposures typical of the Gala 7 unit in this area. Although no bedding surfaces are exposed, the way up of the beds and the direction of dip can be inferred by observing variations in grain size within a bed; bedding dips steeply towards the NW but may be locally overturned. Some of the turbidite beds have pebbly erosive bases which, together with grading, demonstrates younging to the NW. Return to parking place.

## 2 King and Queen: Gala 7 turbidites and sculptures

Drive back along the road towards the dam and park near a small gate into a field on the SW side of the reservoir [NX 844 778]. This gate gives access to a farm track and the best known of the sculptures, a pair of crowned, seated figures known as the 'King and Queen', reputed to be by Henry Moore. Sadly, the statues were vandalised in early 1995. Small outcrops near the statues reveal turbidites which are finer-grained and more thinly bedded than those seen previously. They are characteristic of the lower part of Gala 7. Bedding, grading, way up and ripple cross-bedding are easily seen.

## 3 Margreig Hill: Gala 7 turbidites, dykes and sculptures

A sculpture like a totem pole is situated to the NW on Margreig Hill. This can be reached by continuing for 300 m along the farm track over a stream, then turning right off the track near a red sands tone plinth bearing the name of the sculptor Henry Moore. Walk NW towards the sculpture, to a gate in the wall. Beyond the gate and a stream crossing, porphyritic felsite dykes form prominent outcrops [NX 840 778]. One has been used as a vantage point for a row of shooting butts. Near this dyke, bedding in the host Gala 7 sedimentary rocks dips gently to the north. Walk on up to the foot of the statue [NX 840 779] where bedding resumes its regional steep north-westerly dip. Walk back to the farm track. Note the inscribed granite block with depictions of elephants near the pheasant pens at the foot of the hill [NX 846 775]. There is another sculpture, a bronze figure known as 'Madonna', in a stand of trees [NX 843 770] 500 m further along the farm track. To continue the geological excursion return to the road and drive back towards Shawhead but at Glen Bridge take the first wronging right up the valley of the Glen Burn.

## 4 Glen Burn: Moffat Shale Group, Laurieston Fault, Cairnharrow Formation and sculpture

An abstract sculpture on the roadside adjacent to Glen Burn marks the next stop [NX 845 768]. The statue is a copy after a bronze original by Henry Moore. Park without blocking passing places.

The Glen Burn valley lies along the line of the Laurieston Fault. Turbidites of the Cairnharrow Formation lie SE of the fault; Moffat Shale Group and Gala 7 strata are present to the NW. Dark and greenish grey mudstones of the Moffat Shale Group are exposed in the burn, and in its bank can be seen a small north-south dioritic dyke. Graptolites from the Ordovician *linearis* Biozone have been collected nearby, and other graptolite faunas identified in this Moffat Shale inlier range up to the Silurian *sedgwickii* Biozone. A mudstone at the top of a Gala 7 turbidite in this area has yielded a graptolite fauna of the *turriculatus* Biozone. The transition from hemipelagic sedimentation (Moffat Shale Group) to turbidite accumulation therefore occurred during Llandovery times, (late *sedgwickii* to early *turriculatus* biozones: (Figure 21)).

On the far (south) side of the burn, deeply weathered sandstone of the Cairnharrow Formation forms the bank. Sole structures mark the base of the bed and clearly demonstrate younging to the SE. Cross the stream and walk NE across

the hillside to an old wall. Thickly bedded turbidites of the Cairnharrow Formation are exposed in a small quarry once used as a sheep pen [849 769]. The sandstones contain distinctive reddish mica flakes, and the bases have large groove casts, accentuated by loading. Younging is to the NW; a synclinal fold axis has been crossed in the hanging wall of the Laurieston Fault. Cleavage is well developed in the mudstone component of the turbidites.

## **5 Glen: Laurieston Fault**

Drive SW past Glen Farm. Pause beyond the farm [NX 829 762] to view the topographic expression of the Laurieston Fault. The valley floor is underlain by Moffat Shale, as exposed in the stream bed, but there is generally a cover of Quaternary deposits. A break of slope on the far hillside marks the fault between Moffat Shale Group and Cairnharrow Formation. The feature is most easily distinguished toward the SW, beside a plantation of conifers.

## **6 Ewe Brae: Moffat Shale Group tuffs and mudstones**

Drive on and park near the entrance to a farm track that ascends Ewe Brae [NX 826 756]. Where the track crosses the Glen Burn, mudstones of the Moffat Shale Group are exposed in the stream bed and trackside. All other exposures, forming knolls to the south of the track, are of lapilli ruff. The lapilli, pyroclastic grains of 1 mm or less, are readily distinguished on weathered surfaces as white or pale pink spheres that form a grain-supported texture in a dark matrix. A slight flattening of the lapilli defines bedding. Ordovician graptolites from the *gracilis*, *clingani*, *linearis* and *anceps* biozones have been collected from mudstones above the ruffs in this inlier. The ruffs therefore indicate eruptive volcanic activity in the Iapetus Ocean region during the Ordovician, but location and affinity of the volcanic centres is not known.

Volcaniclastic grains interpreted to be from a volcanic island arc are known from Ordovician turbidite sequences within the Northern Belt (Stone et al., 1987; Styles et al., 1989), and the Moffat Shale ruffs may have come from the same source. Alternatively, they may be related to basalts in the Moffat Shale Group, which are inferred to have been generated by back arc spreading marginal to the Iapetus Ocean or by withinplate volcanism in the Iapetus Ocean (Lambert et al., 1981; Stone et al., 1987).

## **7 Ewe Brae: folding, Cairnharrow Formation and Turner's Monument**

Follow the farm track to a quarry at the crest of Ewe Brae [NX 835 758] where medium-to thick-bedded turbidites of the Cairnharrow Formation are reworked.

Steeply dipping strata, with beds grading from sandstone through siltstone to mudstone clearly young to the NW. Cleavage is well developed in the mudstones, where it is steeply inclined, and is also evident, though refracted, in the finer-grained sandstones. Both cleavage and bedding have been affected by shallow open folds with gently inclined axial planes and hinges that plunge a few degrees toward the SW; fold wavelength is about 4 cm and amplitude is about 2 cm. The folds are obvious on the quarry faces as open crenulations of the first cleavage. This folding is evidence for a second deformation episode (D2) imposed on the thrust-related deformation (D1) that produced the main cleavage. Slickensides on bedding plunge steeply to the SW and are probably associated with movement on the Laurieston Fault.

From this locality Turner's Monument can be seen to the NW, at the summit of Bennan. Johnny Turner was a previous resident of Glen Farm. During his lifetime he built this grand memorial to himself, having sought assurances that he would be interred there after his death. He reputedly chose the isolated hill top so that his grave would not be defiled by visitors. Return via the farm track to the metalled road and parked vehicles.

## **8 Larghill: Moffat Shale Group, Laurieston Fault, Cairnharrow Formation and Martyrs' Monument**

Continue SW for 1.5 km to Larghill Bridge [NX 817 745]. To avoid blocking the entrance to Larghill Farm, park with care on the right a little further on, at the entrance to a private forestry track.

Lapilli tuff within the Moffat Shale Group is exposed in the trackside at Larghill Bridge. One hundred metres further to the NE is a hillside exposure of graptolitic black shale. Peach and Horne (1899) described a graptolite fauna from here but fossil specimens are not abundant. More lapilli tuff can be seen beside the ruined wall farther up the hillside. The line of the Laurieston Fault is marked by the change to a steeper gradient; a spring issues at the fault line.

Approximately 150 m due east of the spring, towards the crest of Larglanglee Hill, turbidites of the Cairnharrow Formation exposed in a small quarry [NX 820 745] comprise thickly bedded, sandstone-dominated units interbedded with thinly bedded mudstone-dominated units. There has been some tectonic disturbance and cleavage is very well developed, perhaps due to the proximity of the Laurieston Fault.

From the quarry walk south to the cluster of trees on the crest of Larglanglee Hill [NX 819 744]. In the SW corner of the plantation, turbidites of the Cairnharrow Formation can be seen in a series of exposures. Younging is towards the NW. The lowest beds comprise a thinning-and fining-upward sequence, over an interval of approximately 8 m. Thickly bedded turbidite units dominated by sandstone form the base and are overlain by medium to thinly bedded units of slightly finer-grained sandstone. The top of the sequence is of thinly bedded units of fine-grained sandstone grading into siltstone and mudstone. Such thinning-and fining-upward sequences in submarine fan deposits are thought to record the gradual abandonment of a distributary channel in a mid-fan setting (Walker and Mutti, 1973). Cleavage is only weakly developed in the mudstone tops of the turbidite units but is non-axial planar to the S1 fold structures. The strike of cleavage is rotated about 10° clockwise from the strike of bedding typical of the incongruent relationship between bedding and first cleavage seen in many Southern Uplands turbidite sequences. Cleavage formation may well have postdated the initial phase of folding; if so the relationship between cleavage and bedding cannot reliably be used to determine fold geometry or the way up of the bedding. A further complexity here is the folding of bedding about small, open subhorizontal D2 hinges.

From Larglanglee Hill a Martyrs' Monument and walled Martyrs' Grave can be seen to the NW across Brooklands Burn.

## **9 Brooklands Burn: graptolitic Moffat Shale Group and Martyrs' Monument**

The course of Brooklands Burn can be reached by walking 430 m SW to the foot of Larglanglee Hill and through a gate in the wall adjacent to the farm track [NX 817 743]. An exposure of Moffat Shale excavated in 1991 in the Brooklands Burn [NX 812 742] contained abundant graptolites. Faunas typical of the top *clingani* and low *linearis* biozones (late Ordovician) were collected. The shales are relatively undeformed, although the effects of small-scale faulting, folding and imbrication of bedding can be seen. From this locality return to the parking place at the entrance to the forestry track.

The Martyrs' Monument and walled Martyrs' Grave [NX 810 751] that were seen from the summit of Larglanglee Hill can be reached by walking for approximately 1 km along the private forestry track which is part of Craighadam Farm. The granitic monument is unweathered and the inscriptions, describing the death of Covenanters by shooting, can be easily read. The red sandstone gravestone and wall, which includes a stepped stile, have not withstood the effects of the elements so well.

## **10 Brooklands Bridge: view of Laurieston Fault**

Drive approximately 1 km SW from Larghill Farm. The road runs approximately parallel to the Laurieston Fault. Stop at the entrance to a second forestry track near Brooklands Bridge [NX 809 740] to view the topographic expression of the Laurieston Fault. Looking WSW the fault is seen as a dry valley. This is a fine example of a tract-defining fault associated with outcrops of the Moffat Shale Group; erosion of the soft lithologies has produced this surface expression of the structure. South of the fault are the turbidites of the Cairnharrow Formation (localities 4, 5, 7 and 8). The sequence to the north comprises very thickly bedded, sandstones of the Gala 7 unit (Localities 11 and 12).

## **11 Crofts Hill Quarry: deformation, Gala 7 turbidites**

Drive south for 1.5 km from Brooklands Bridge to the crossroads with the A712 and turn right towards Balmaclellan. Continue on 1.7 km and park in a small lay-by on the right-hand side of the road, at a sharp left-hand bend [NX 792 734]. A gateway leads from the lay-by into a field which has been recently planted with trees (1994) and contains a disused quarry [NX 792 735].

In this area (Figure 20) Gala 7 turbidite beds have been folded into large-scale, NW verging folds. Very thickly bedded turbidites of Gala 7 are well exposed in the quarry, which has been worked within a fold limb that dips and youngs SE, as demonstrated by the well-exposed rippled top of a sandstone bed. The palaeocurrent direction, inferred from the asymmetry of the ripples, was also towards the SE.

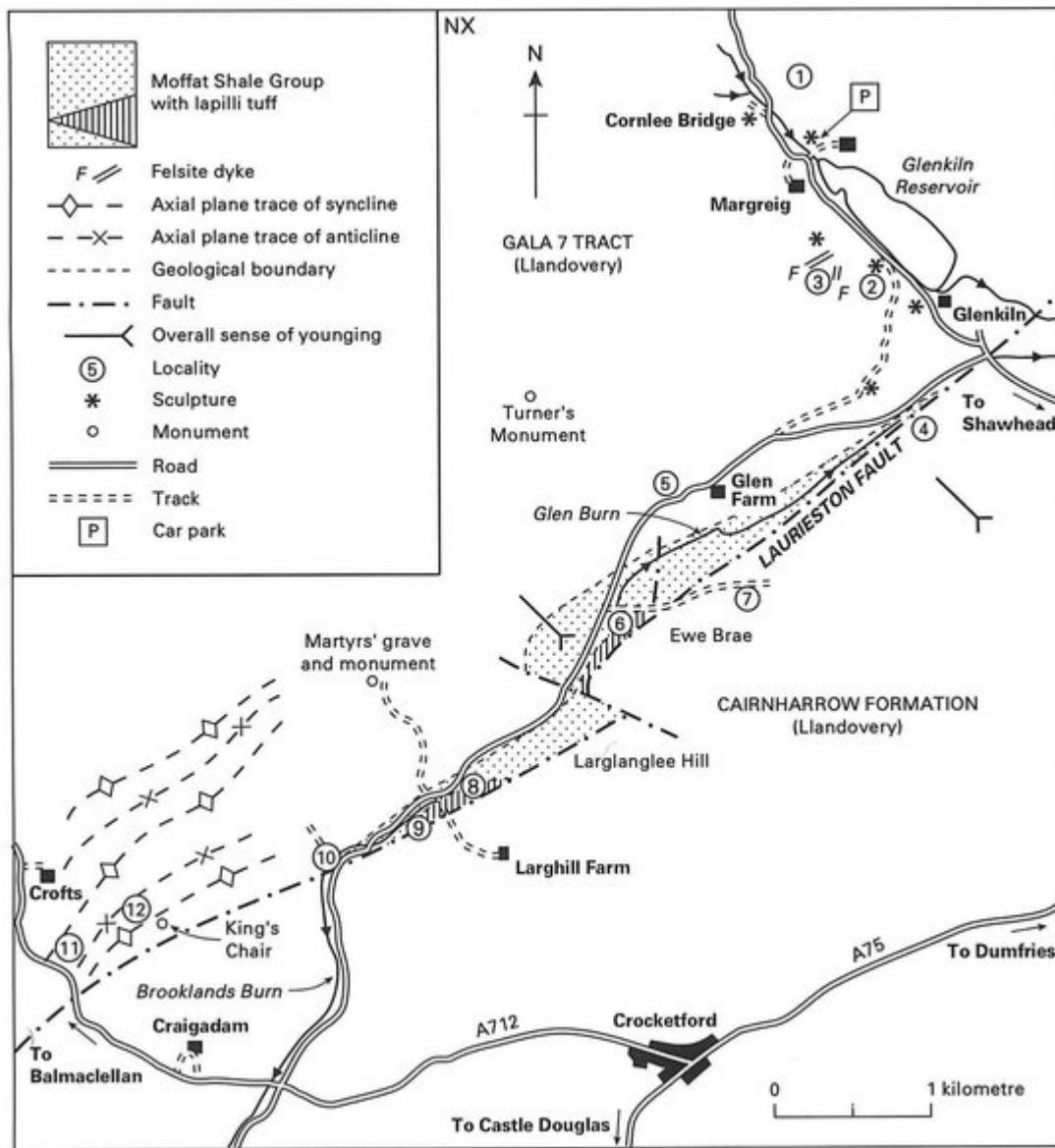
Mudstone comprises only a small proportion of the turbidite units. In Crofts Hill Quarry these fine-grained lithologies have been imbricated into a narrow duplex structure between the massive sandstone beds by bedding-parallel shear, probably induced by folding. Reddening of the rocks is attributed to uplift and subaerial weathering in a desert environment during the Upper Palaeozoic.

## **12 Crofts Hill and Kings Chair: folding of Gala 7 turbidites**

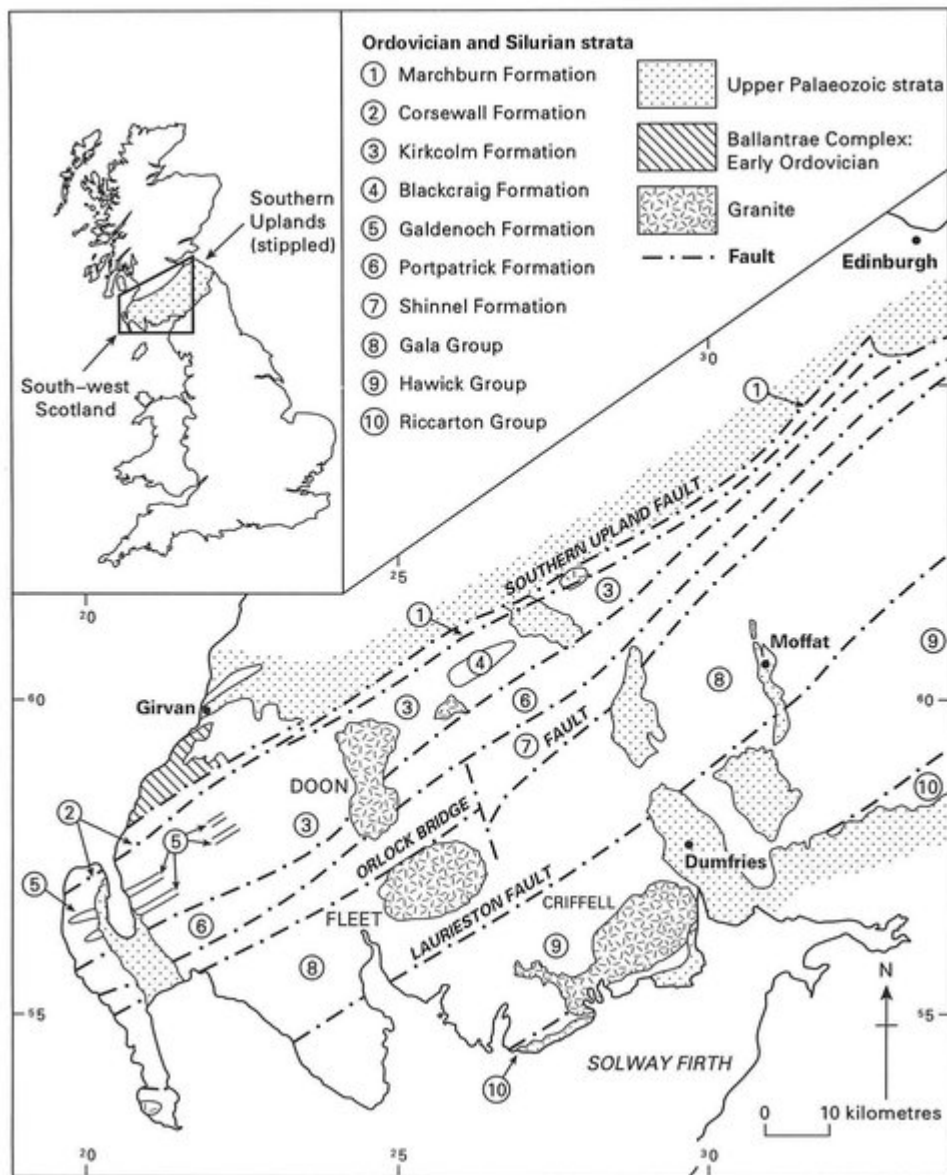
From the quarry walk NE along the crest of the hill to the summit cairn of Crofts Hill [NX 793 737]. Many gently dipping beds are exposed; in fact, unusually for the Southern Uplands, most of the flat or rounded rock surfaces on Crofts Hill are bedding planes. The direct route to the hilltop is along strike within the SE-dipping and SE-younging fold limb. From the summit walk due east. As you approach a boundary wall a synclinal fold axis is crossed and bedding resumes the regional strike and dip, steeply inclined and younging to the NW. However, looking over the wall, large exposures of thickly bedded sandstone dipping and younging SE can be seen between newly planted trees. These form the next gently dipping fold limb beyond an anticlinal hinge. The anticlinal fold axis can be traced as far as a small memorial (to a previous landowner) on Kings Chair and thence across the boundary wall. The south-easterly dip increases from about 30° to 70° towards the Laurieston Fault.

From here northwards to Lochenkit Loch the landscape is very much influenced by large-scale D1 folds. Steeply dipping, NW-younging fold limbs form the high ground, the lower ground being underlain by gently inclined south- and SE-dipping limbs. The effects of a later phase of folding, D2, are much more modest than D1 and can be seen in a small quarry near the boundary wall [NX 795 737]. There the steeply dipping bedding youngs to the NW, as is evident from grading, sole structures and ripple lamination. In the east corner of the quarry, on a north-facing surface, a siltstone bed has been folded into second phase folds with an amplitude of less than 10 cm. The axial planes are horizontal. In this quarry, D2 crenulation of S 1 cleavage can also be seen within the mudstone tops of the sandstone-dominated turbidites. From the quarry return to the lay-by. To join the A75 drive back along the A712 towards Crocketford.

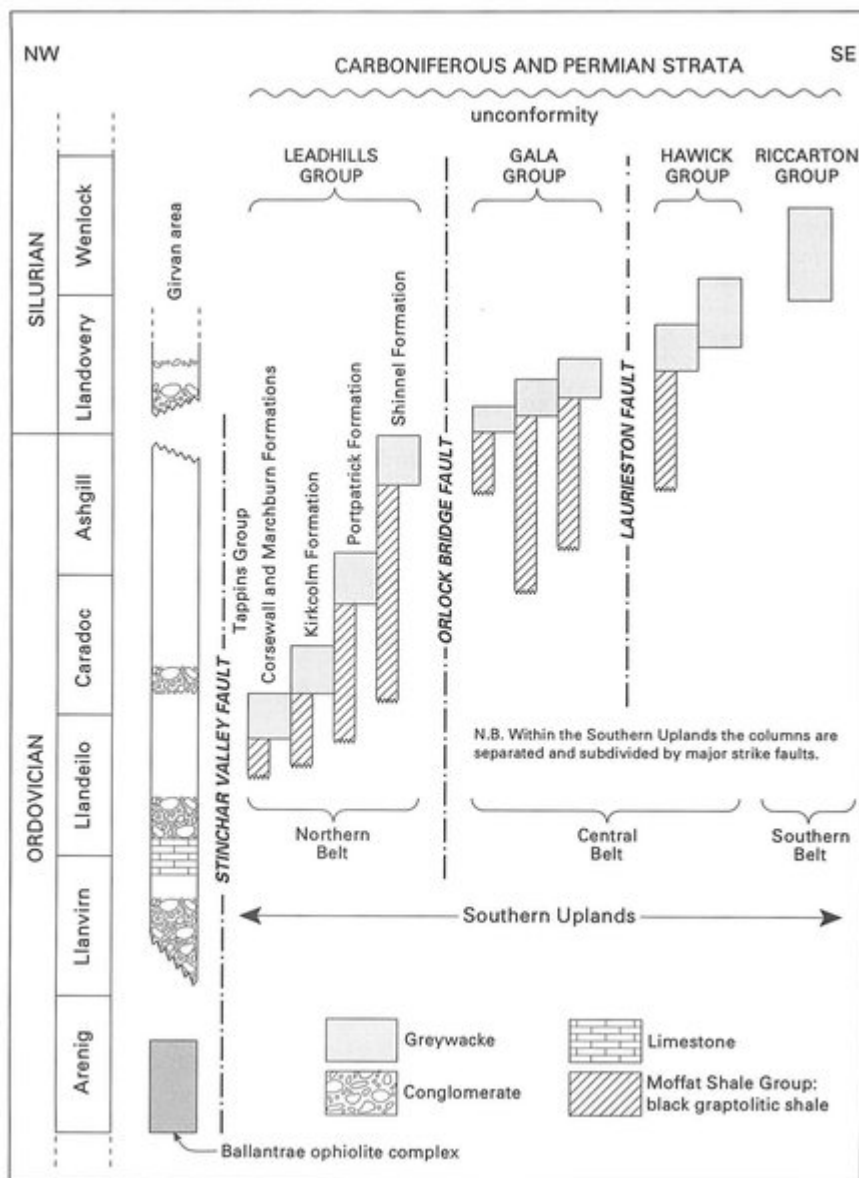
## **[References](#)**



(Figure 20) Locality map and outline geology for the Shawhead excursion in the Crockford area.

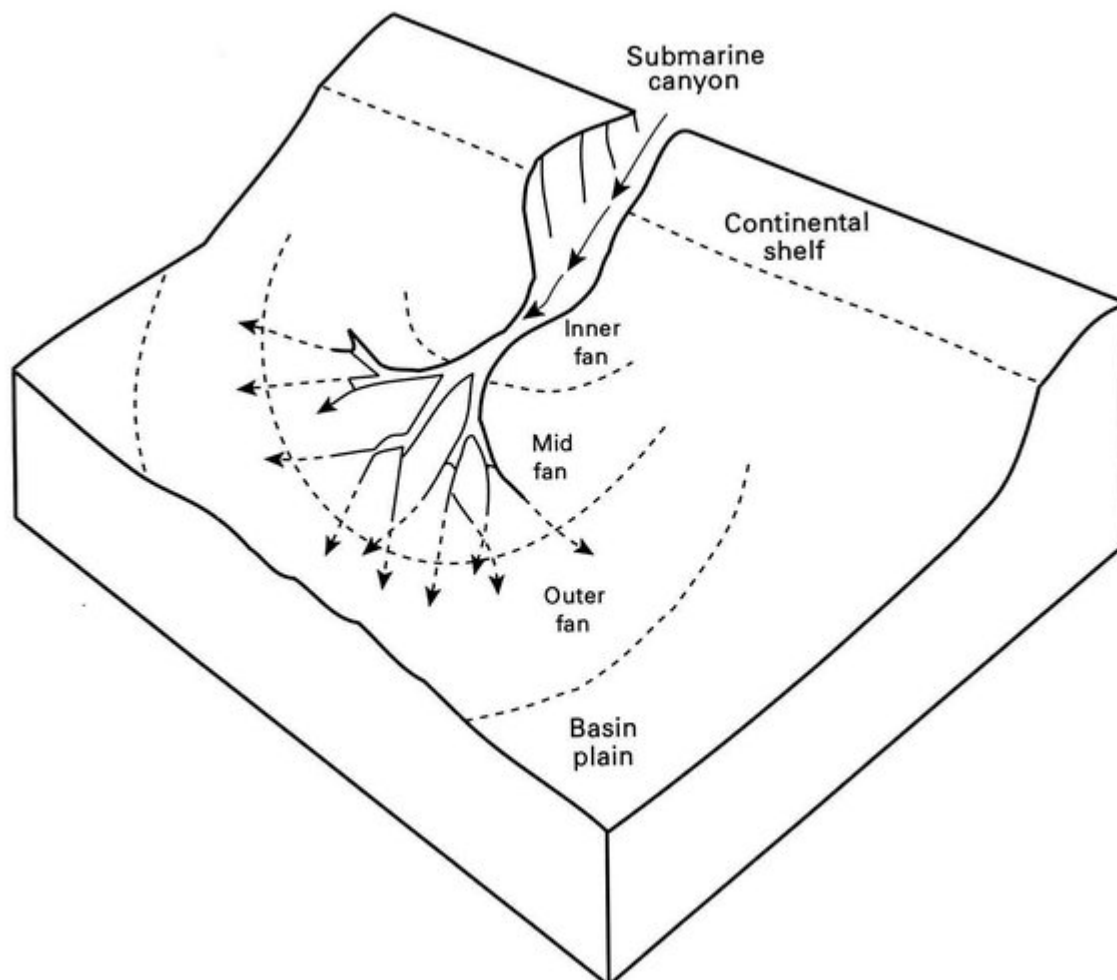


(Figure 1) Principal features of Lower Palaeozoic geology in south-west Scotland.

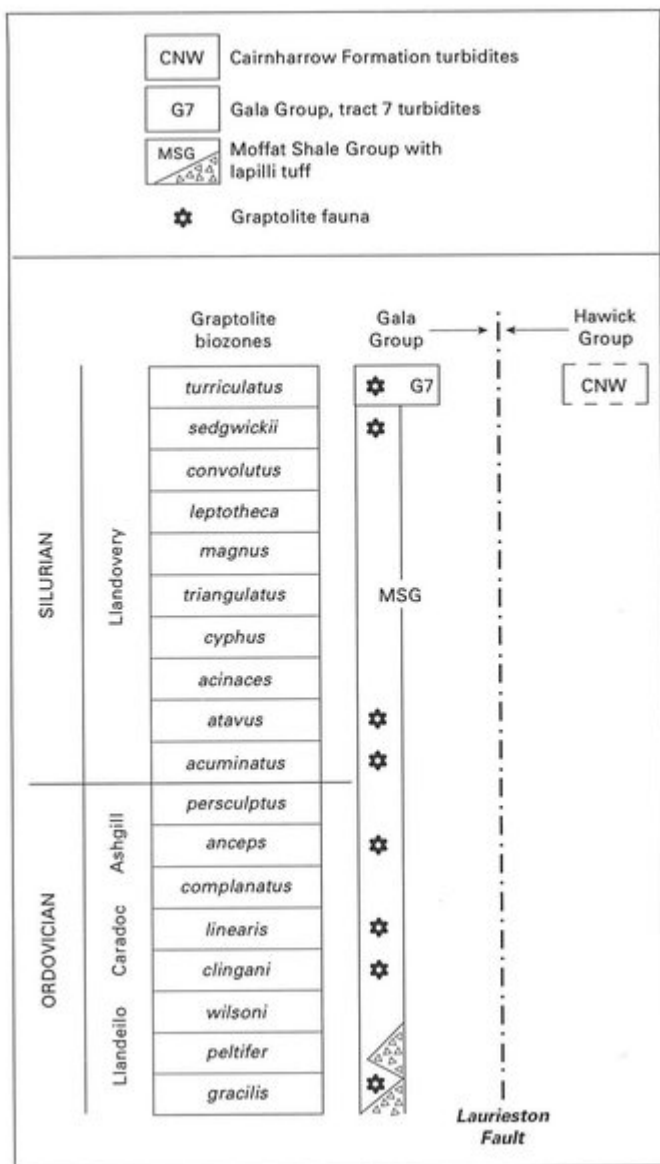


(Figure 2) Schematic representation of stratigraphical relationships in south-west Scotland.





(Figure 7) Depositional environments on a submarine fan.



(Figure 21) Graptolite biostratigraphy for the Moffat Shale, Gala and Hawick groups in the Shawhead area.